

COSPAR Abstract for Warsaw, Poland, 2000

SUBSTORMS, PSEUDOBREAKUPS AND QUIESCENT EVENTS CAUSED BY INTERPLANETARY SHOCKS

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We use WIND solar wind data and POLAR UV imaging data to study magnetospheric responses and substorm triggering mechanisms during and after interplanetary (IP) shock events. Of 53 IP shock events that occurred in 1997 and 1998 at WIND, 18 events have POLAR near-midnight UV images available. All of these 18 events are used in this study. The nightside auroral responses are classified into three types: substorm expansion phase (SS) (or substorm further intensification) events, pseudobreakup (PB) events, and quiescent (QE) events. It is found that the solar wind precondition determines the causes of the different auroral responses, with a ~ 1.5 hr "precondition" (upstream of the IP shock) giving the best empirical results. The upstream IMF B_z is strongly southward prior to substorm triggerings (44% of all events), the IMF B_z is ~ 0 nT for PB triggerings (39% of all events), and the IMF is almost purely northward for quiescent events (17%). A magnetotail-compression substorm triggering model is developed and presented. This model uses dayside magnetic reconnection to load the near-Earth plasma sheet and a current disruption mechanism to unload the stored energy. We call this model a Dripping, Tilting Bucket (DTB) model.

Abstracts to be submitted on or before January 7, 2000 to Copernicus Office with copy to appropriate Main Scientific Organizer:

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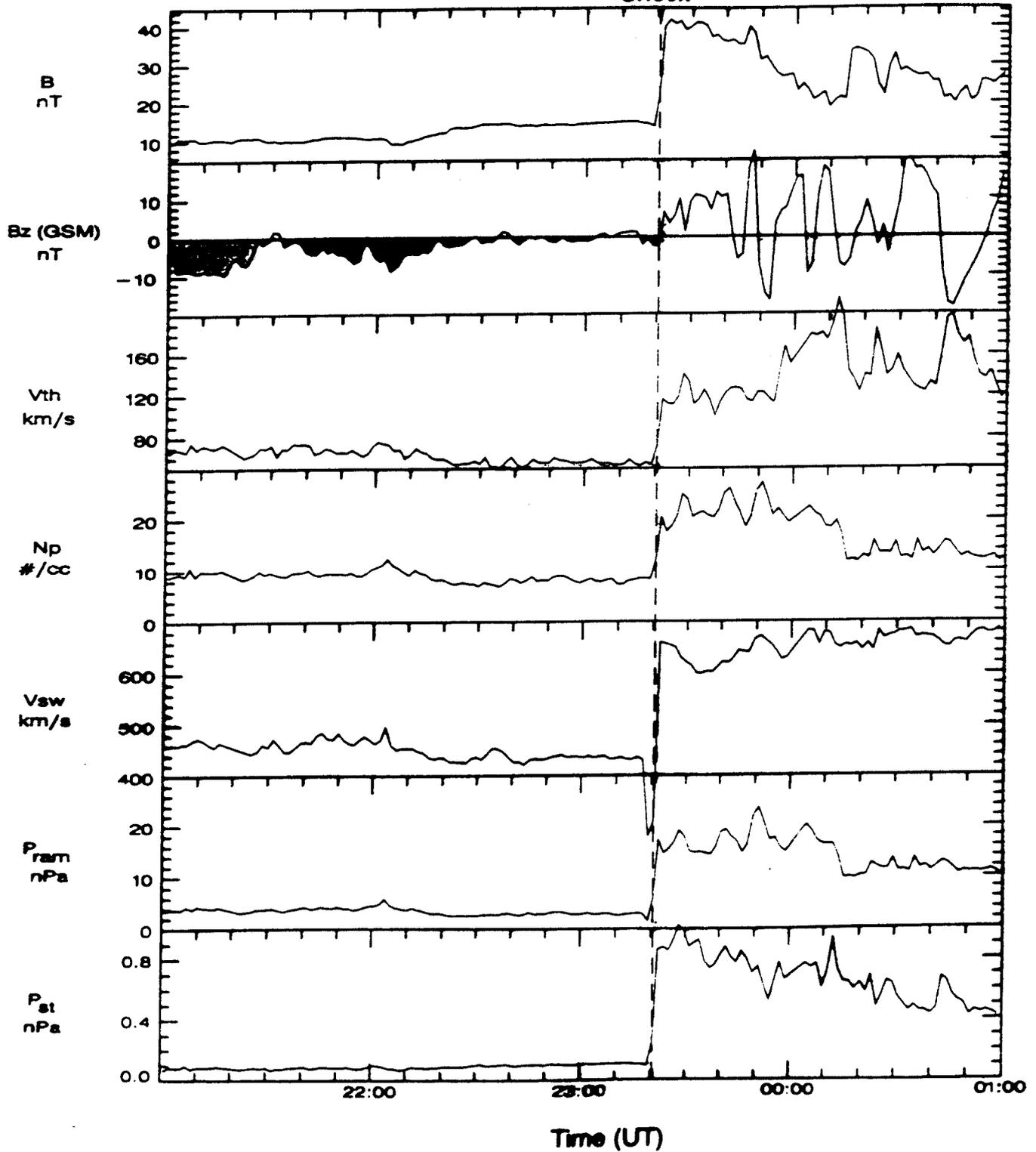
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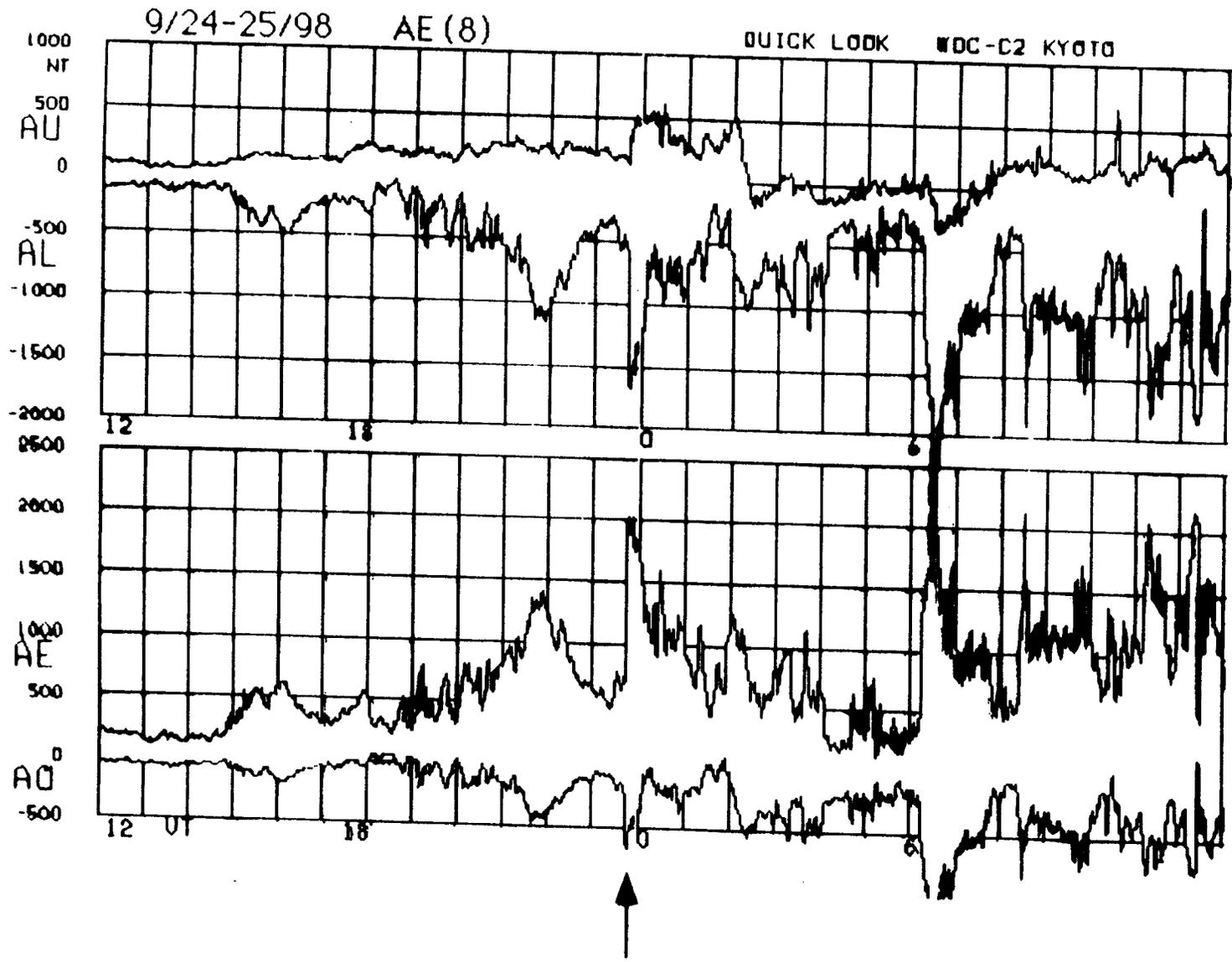
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WIND - September 24, 1998

Shock





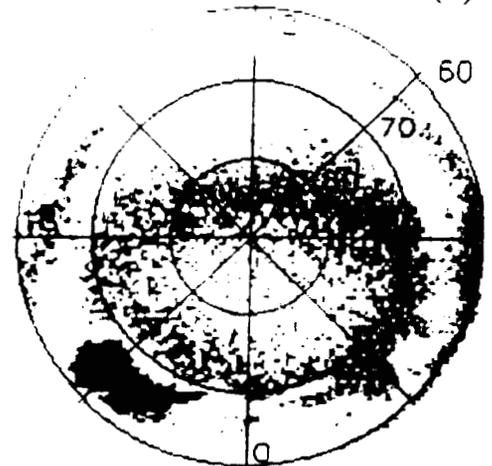
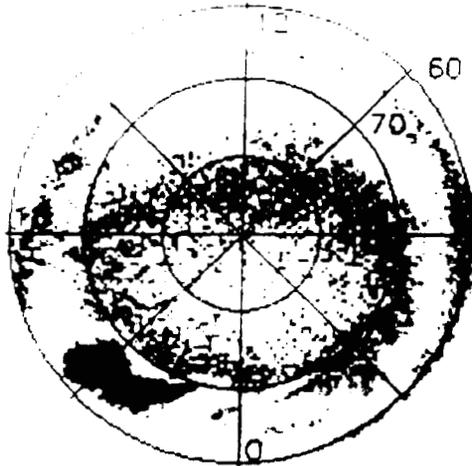
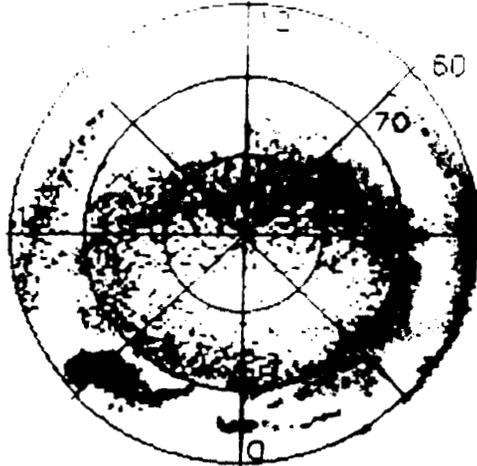
IP shock triggered
substorm intensification

IP shock Arrival

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23:43:30 UT (b)

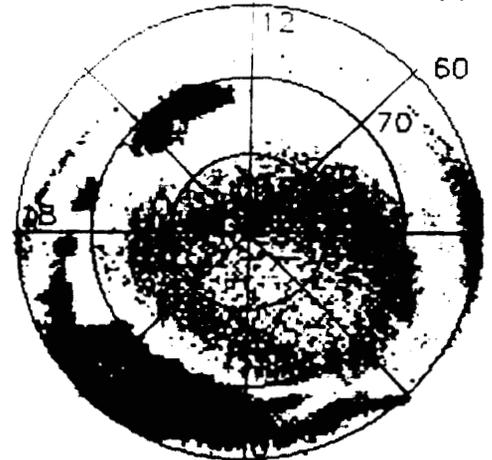
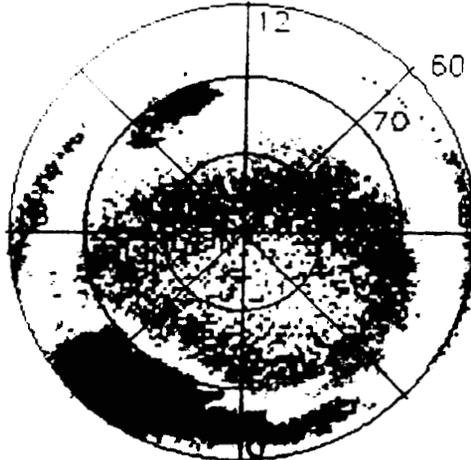
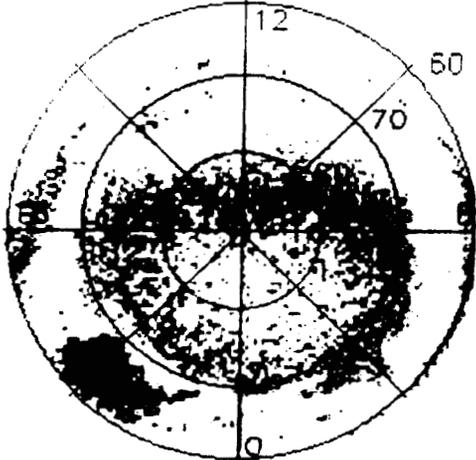
23:44:44 UT (c)



23:45:57 UT (d)

23:47:11 UT (e)

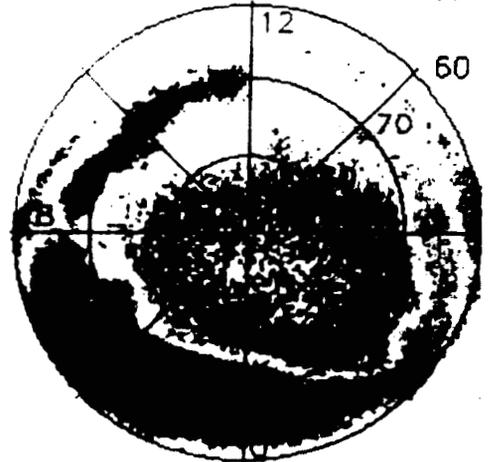
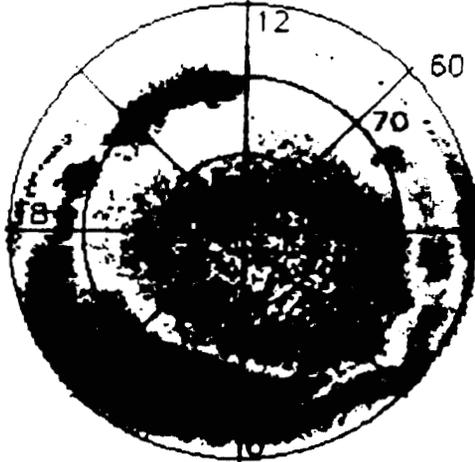
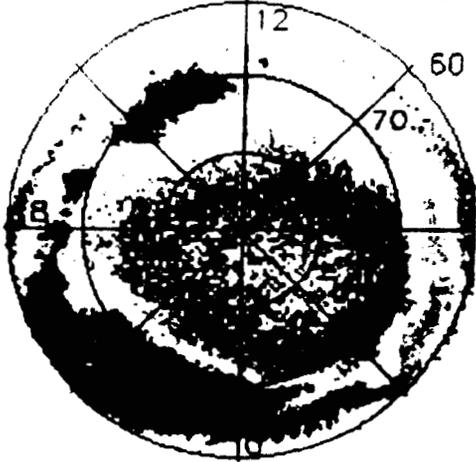
23:48:25 UT (f)



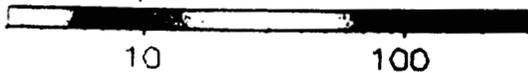
23:49:01 UT (g)

23:50:15 UT (h)

23:51:29 UT (i)



photons $\text{cm}^{-2} \text{s}^{-1}$

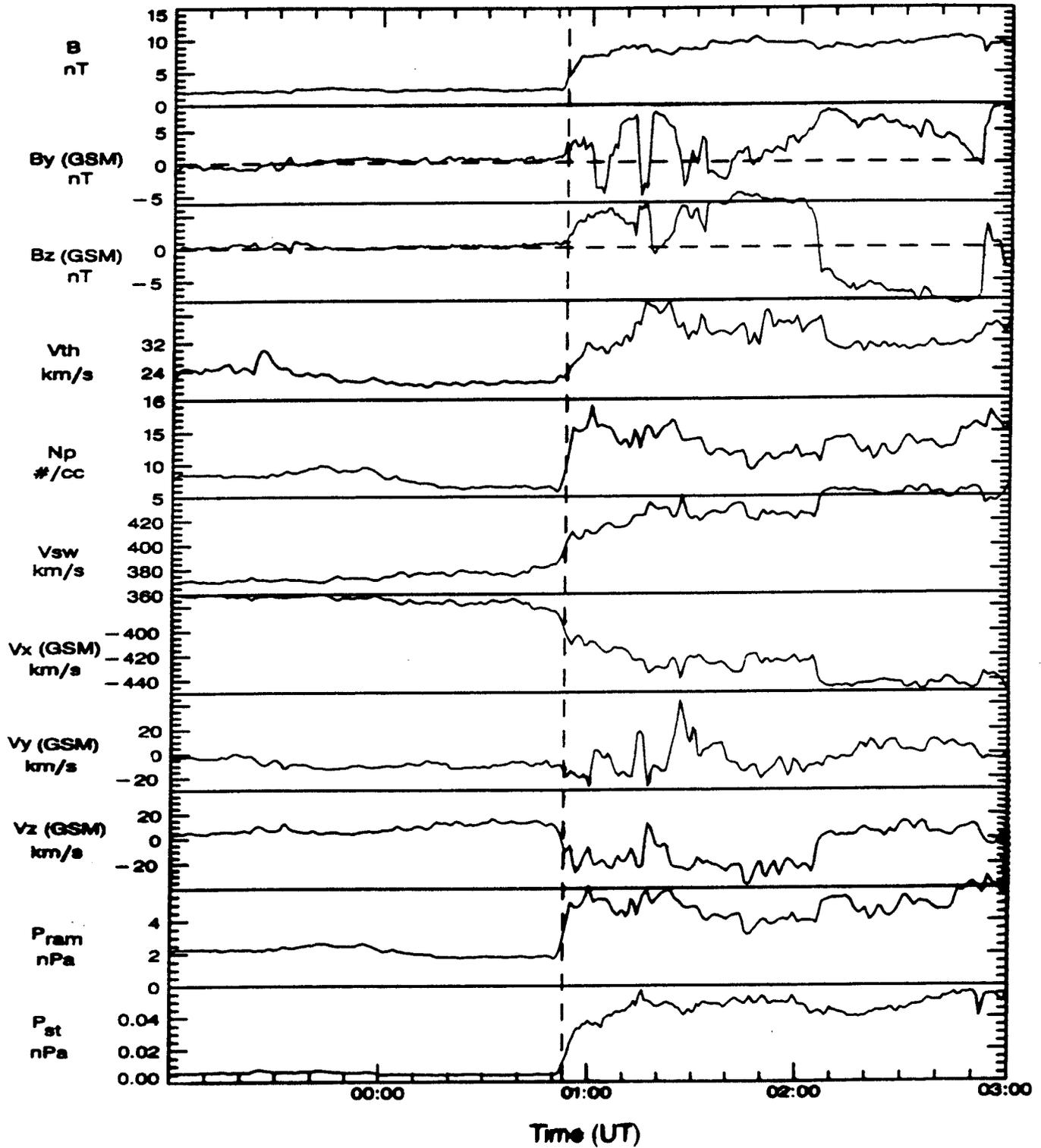


10

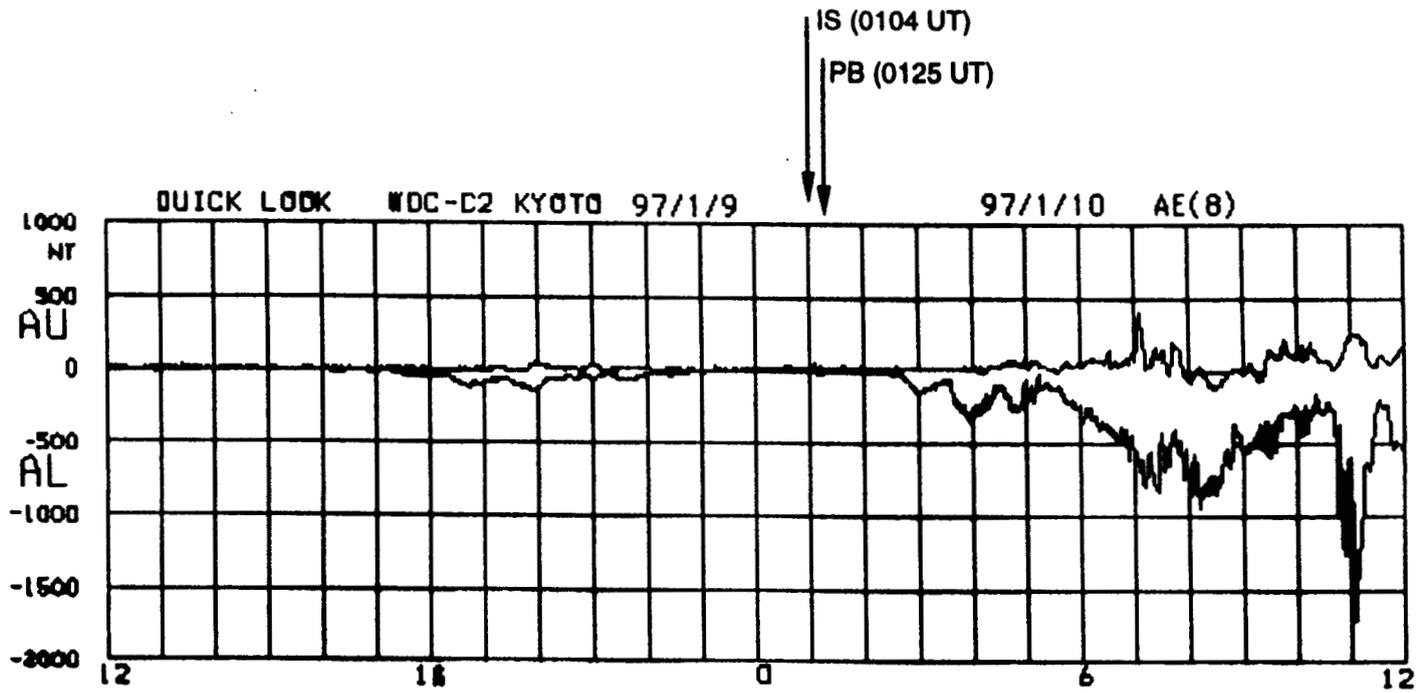
100

POLAR UVI LBHL September 24, 1998

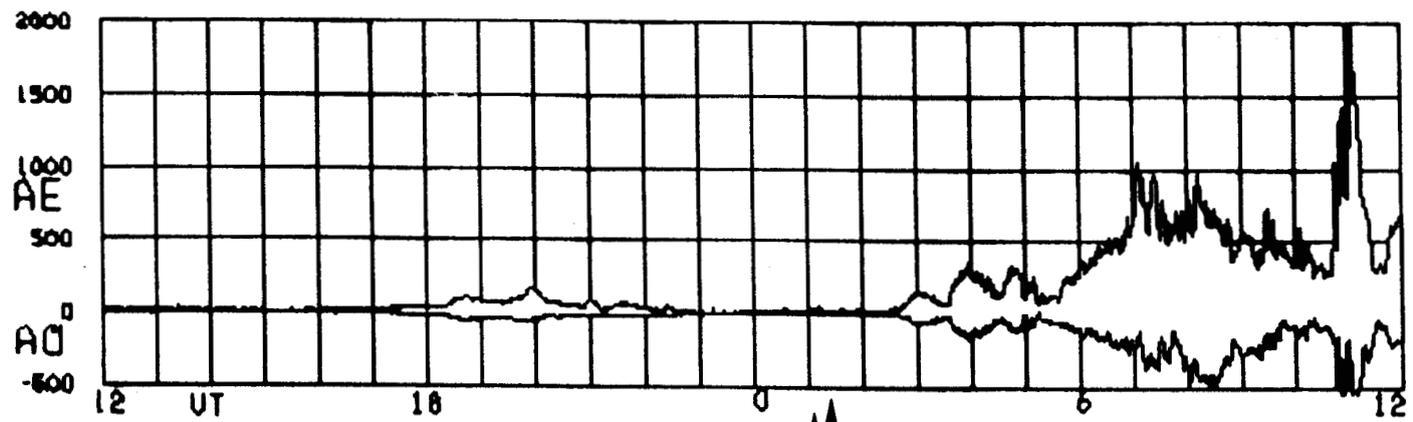
WIND - January 10, 1997



	00:00	00:58	01:00	02:00	03:00
Xgsm (Re)	84.3	84.7	85.1	85.4	85.8
Ygsm (Re)	-54.9	-54.9	-55.2	-55.8	-56.6
Zgsm (Re)	-23.3	-23.1	-22.1	-20.4	-18.1

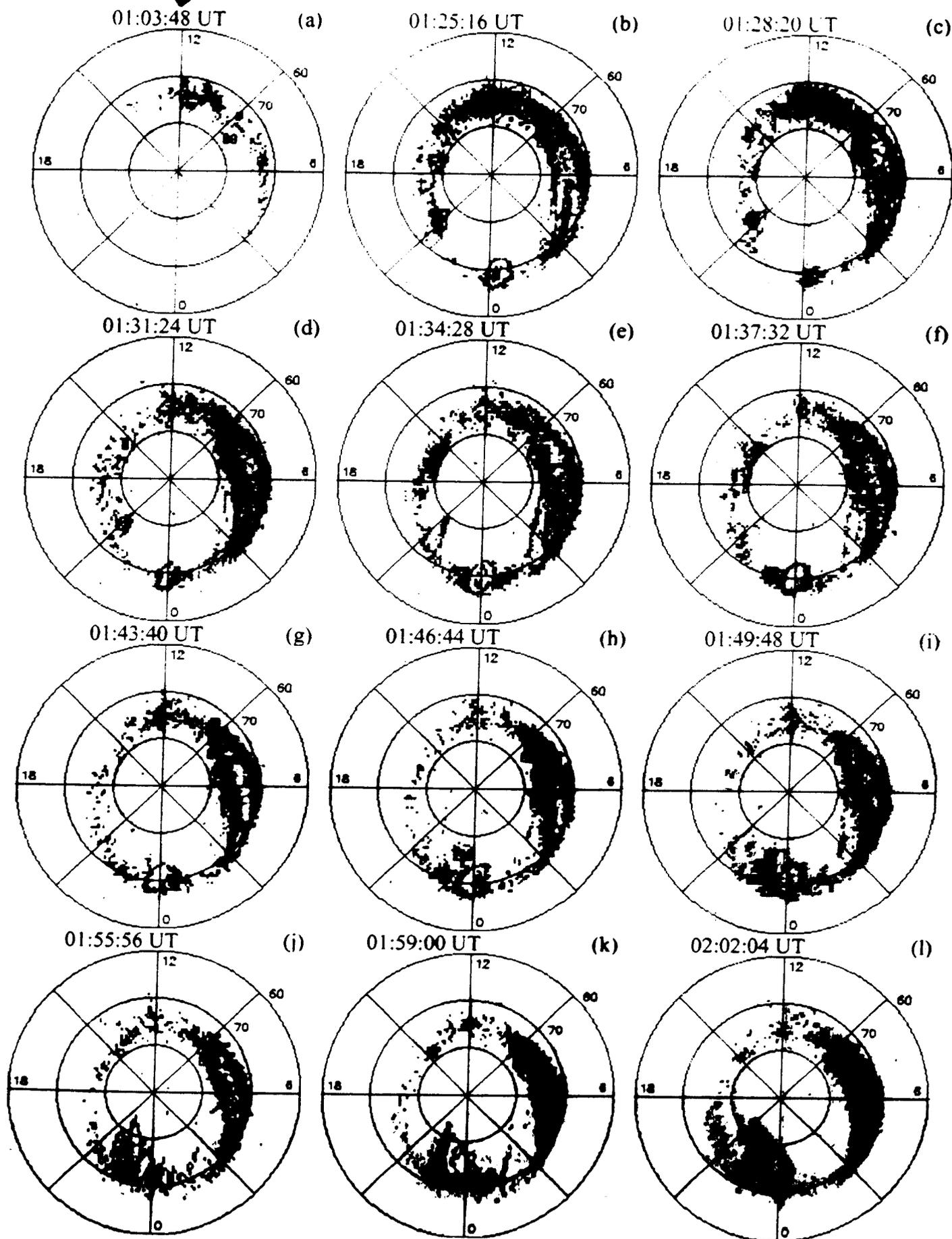


IS (0104 UT)
PB (0125 UT)

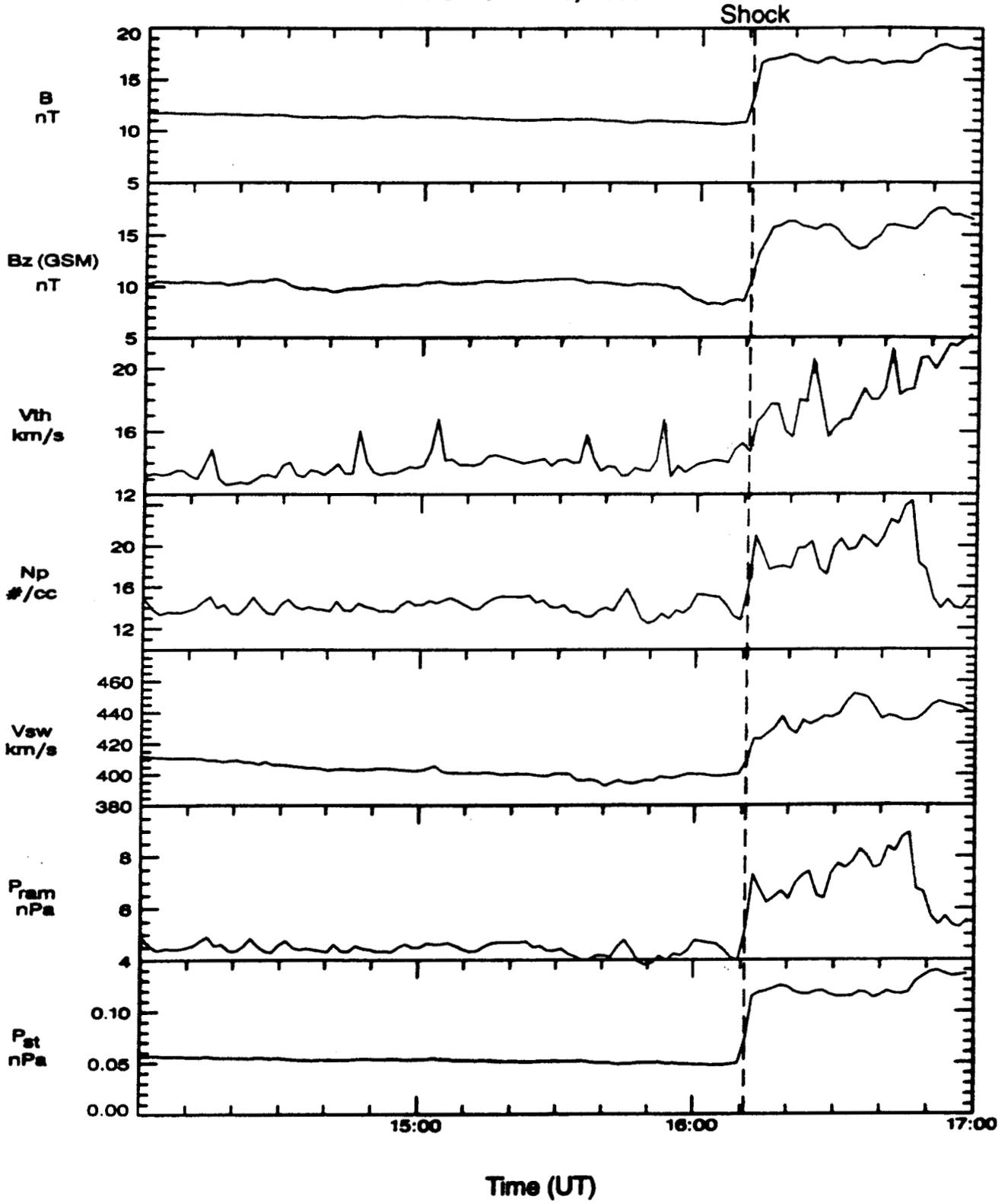


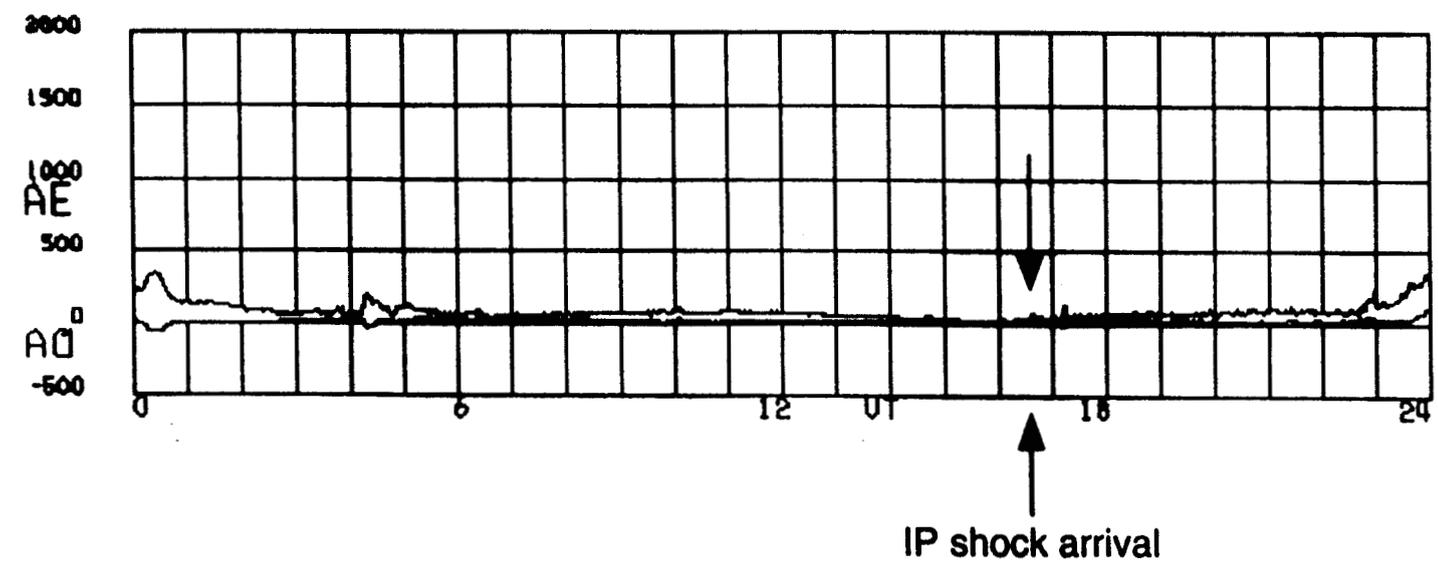
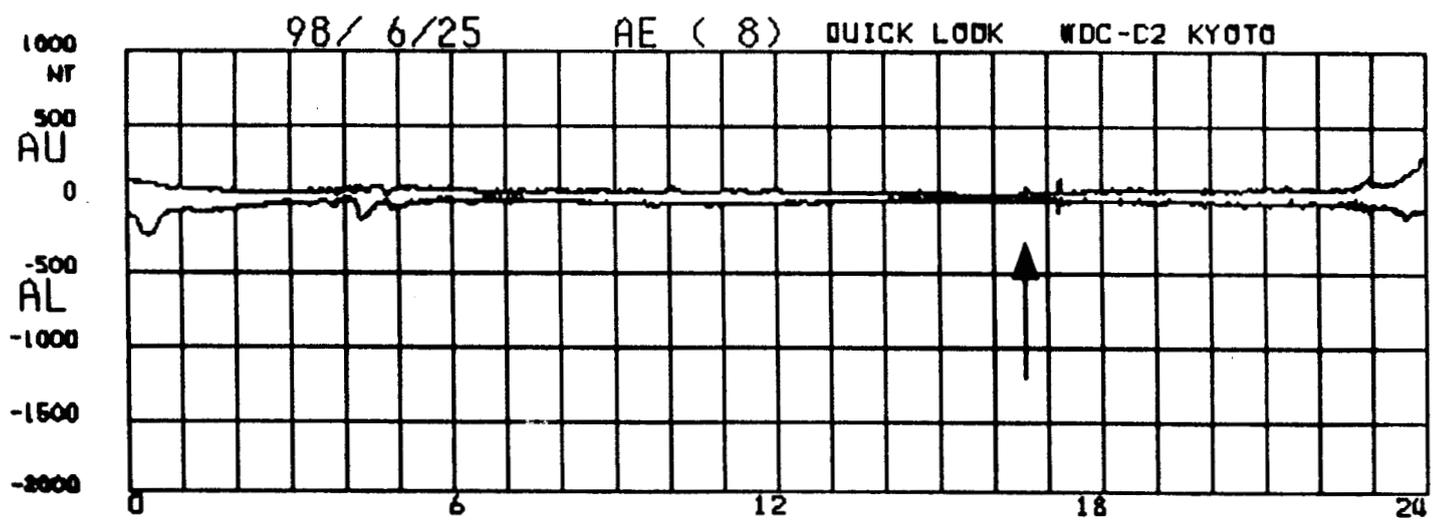
PB (0125 UT)
IS (0104 UT)

IP Shock arrival

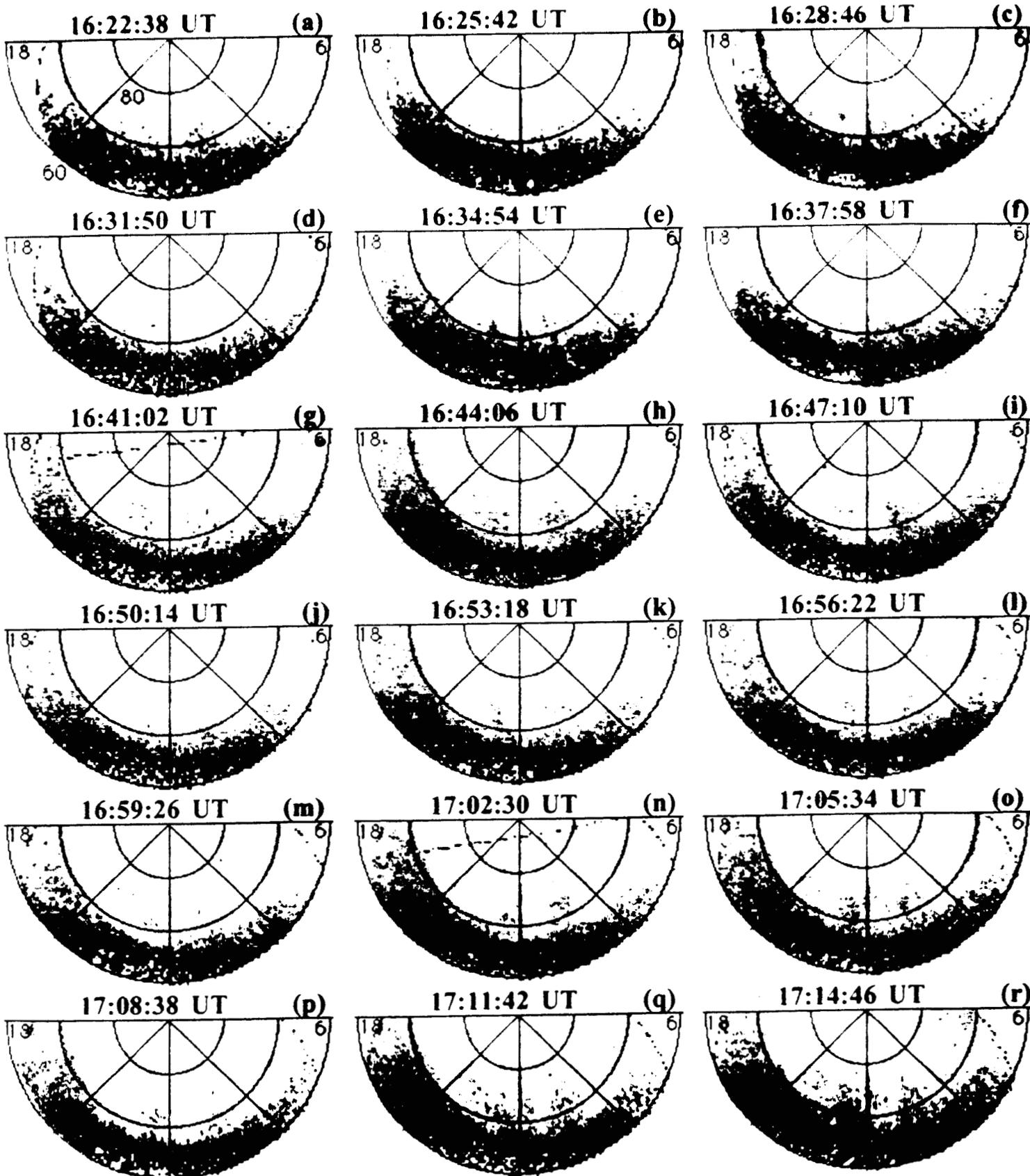


WIND - June 25, 1998

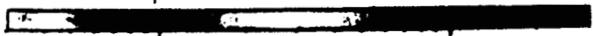




IP Shock Arrival



photons $\text{cm}^{-2} \text{s}^{-1}$



10

100

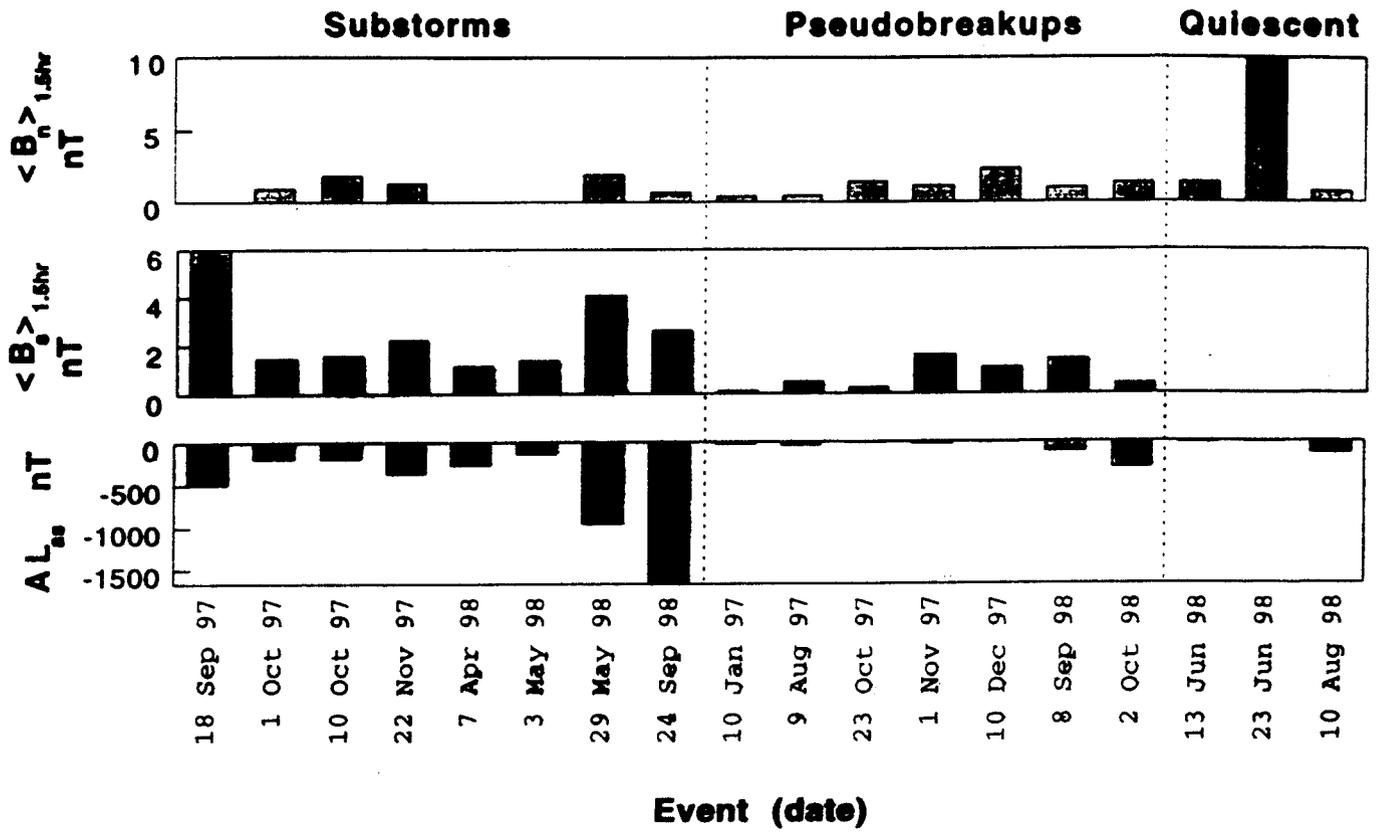
POLAR UVI LBHL

June 25, 1998

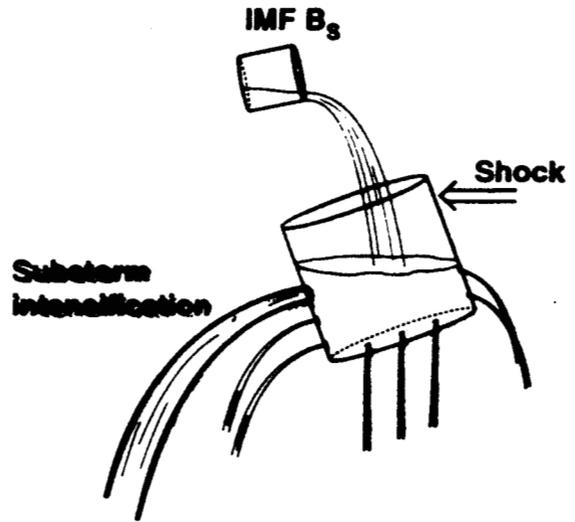
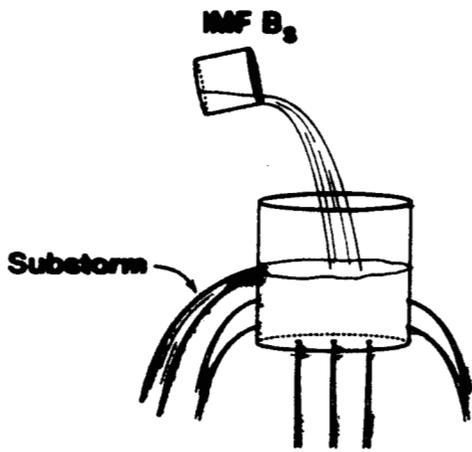
Associated IMF Bz turning events

(Within expected time ± 15 min)

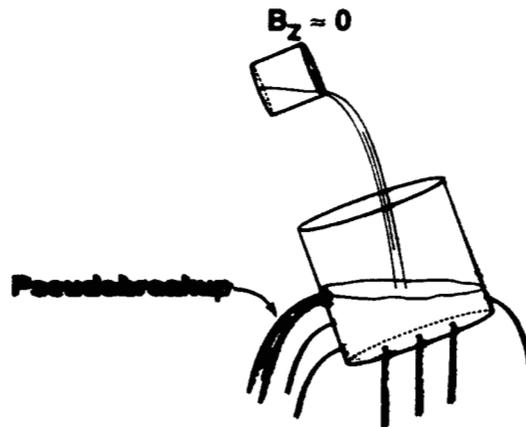
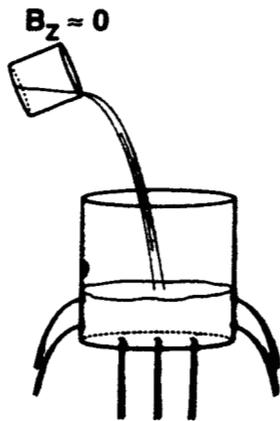
Type	Date	IMF Bn (nT) Events	IMF Bs (nT) Events
SS	Sep 18, 1997	No	No
	Oct 1, 1997	No	No
	Oct 10, 1997	Yes	No
	Nov 22, 1997	No	No
	Apr 7, 1998	No	No
	May 3, 1998	No	No
	May 29, 1998	No	Yes
	Sep 24, 1998	Yes	No
PB	Jan 10, 1997	No	No
	Aug 9, 1997	Yes	No
	Oct 23, 1997	No	No
	Nov 1, 1997	No	No
	Dec 10, 1997	No	No
	Sep 8, 1998	No	Yes
	Oct 2, 1998	No	No



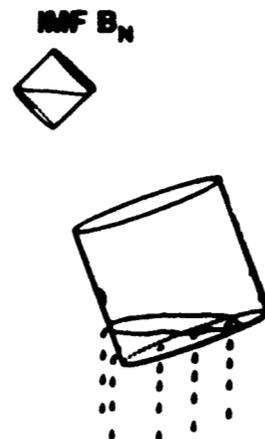
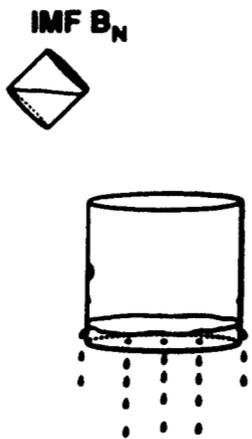
Dripping, Tilting Bucket Model



a)



b)



c)

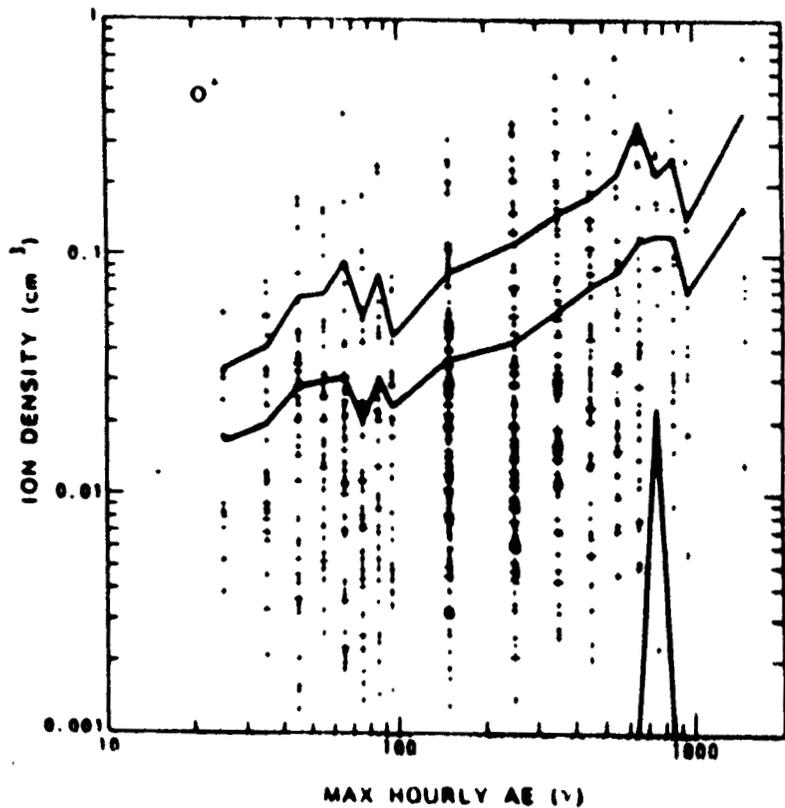


Fig 6 A scatter plot of all the individual samples of the O^+ number density. The three lines show the average (middle line) and the average plus or minus one sample standard deviation (as opposed to a standard deviation of the average itself). The lowermost of these three is partly below scale.

Lennartsson & Shelly JGR. '98

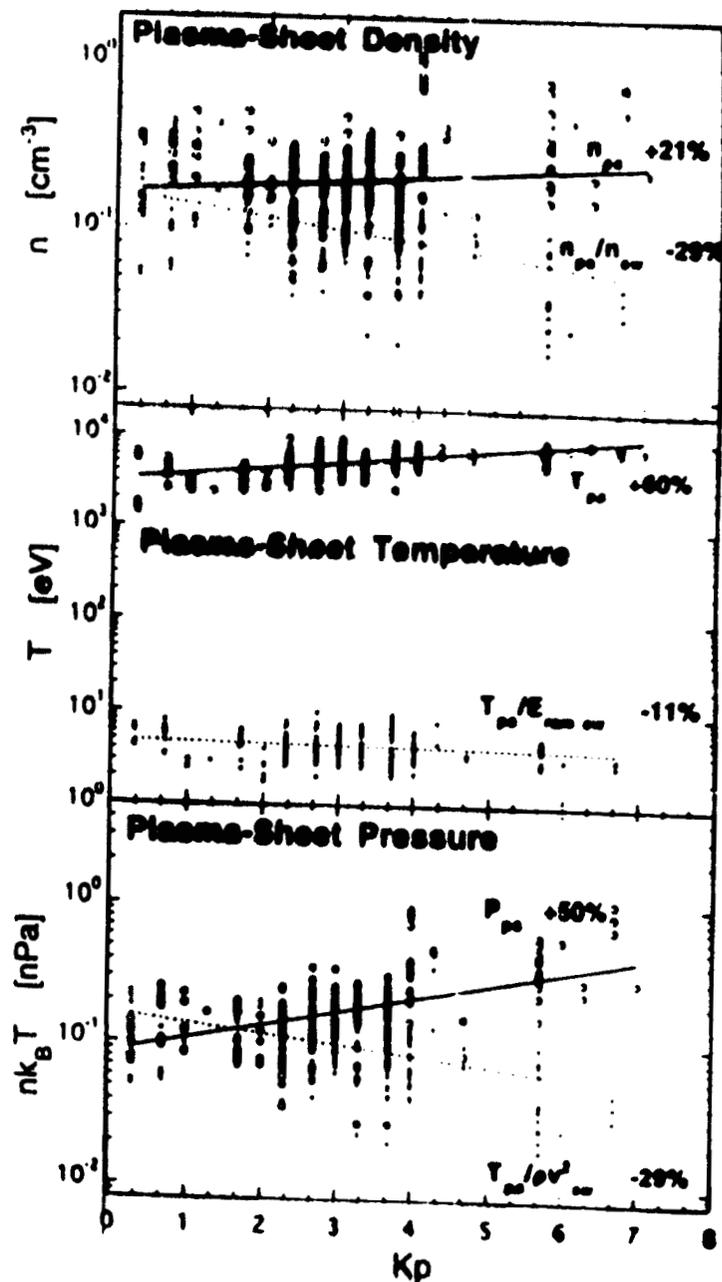
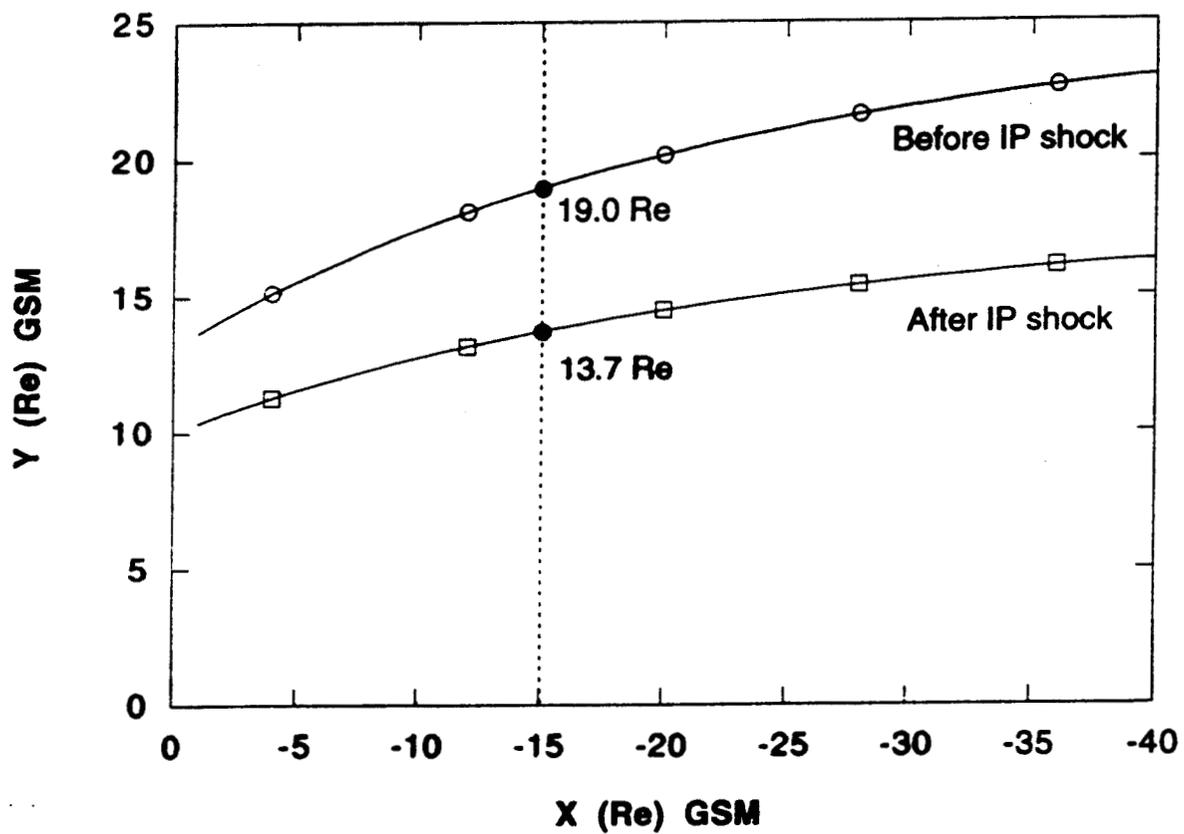
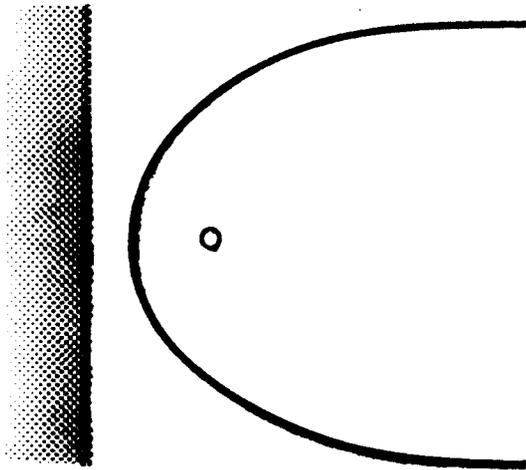


Figure 9. For neutral-sheet encounters between 17.5 and 22.5 R_E , the density, temperature, and particle pressure of the plasma sheet are plotted as functions of K_p and then normalized to instantaneous solar wind quantities and re-plotted.

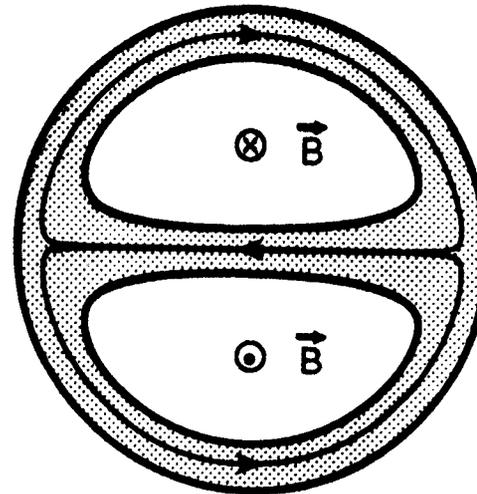
By ... + 1 - ...



Shock front

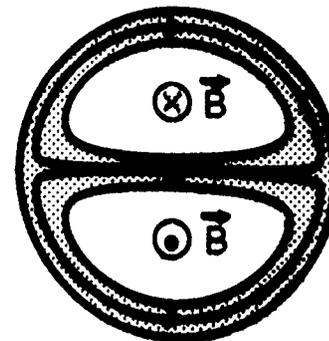
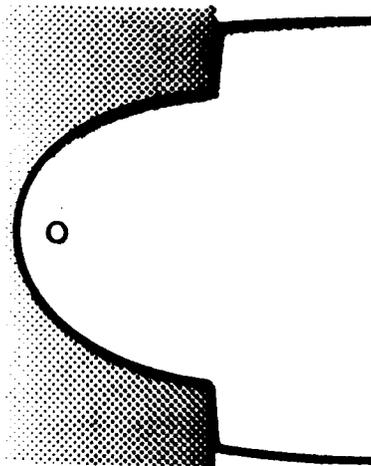


Magnetotail



(a)

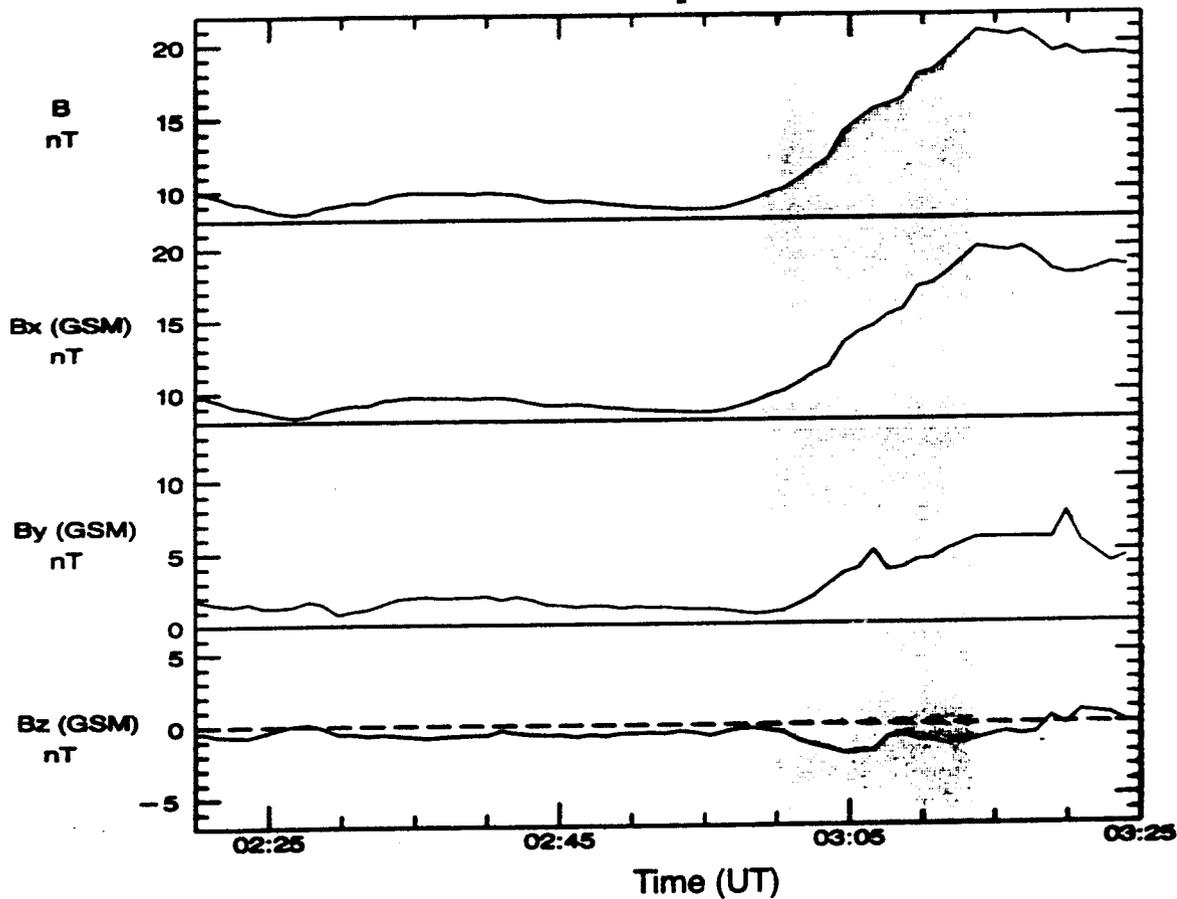
Shock front



(b)

Figure 8

IMP 8 - July 24, 1995



X (Re GSM)	-31.3	-31.2	-31.1	-31.1
Y (Re GSM)	-12.3	-12.4	-12.4	-12.4
Z (Re GSM)	8.5	8.9	9.3	9.6

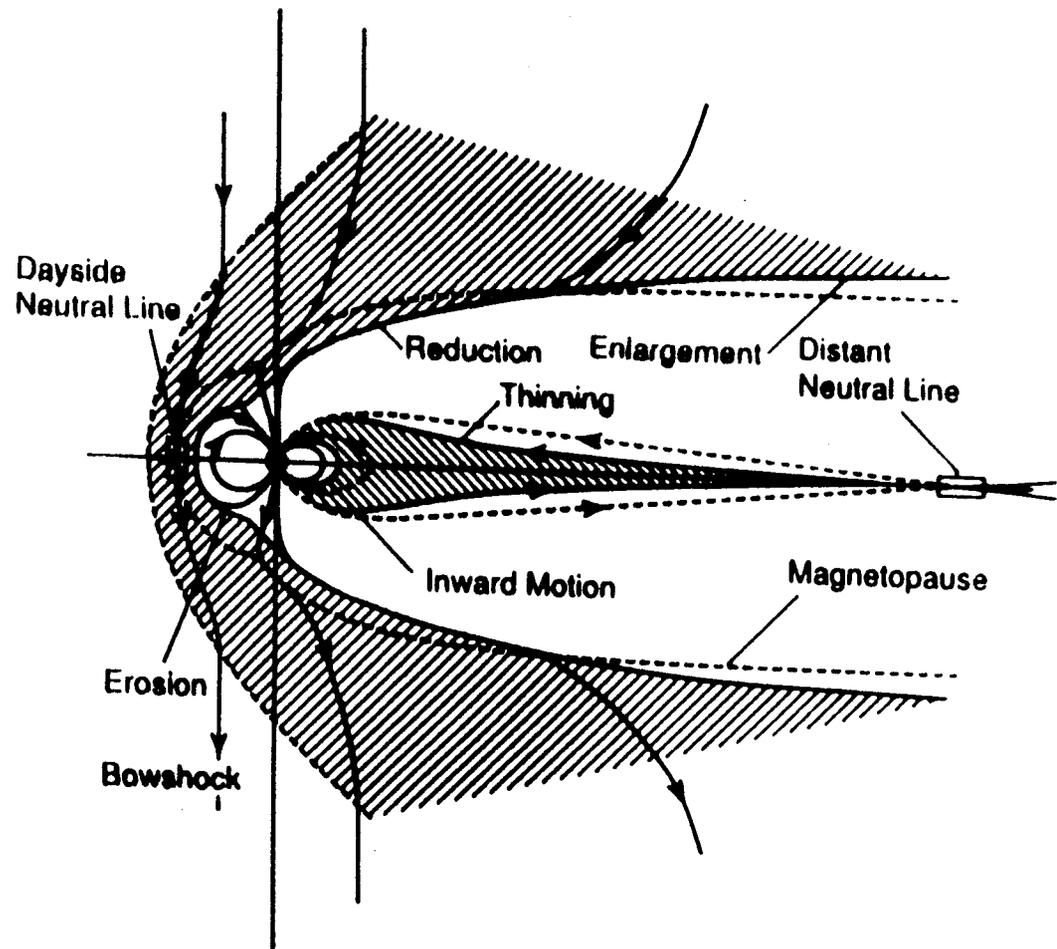
TRIGGERING MECHANISMS

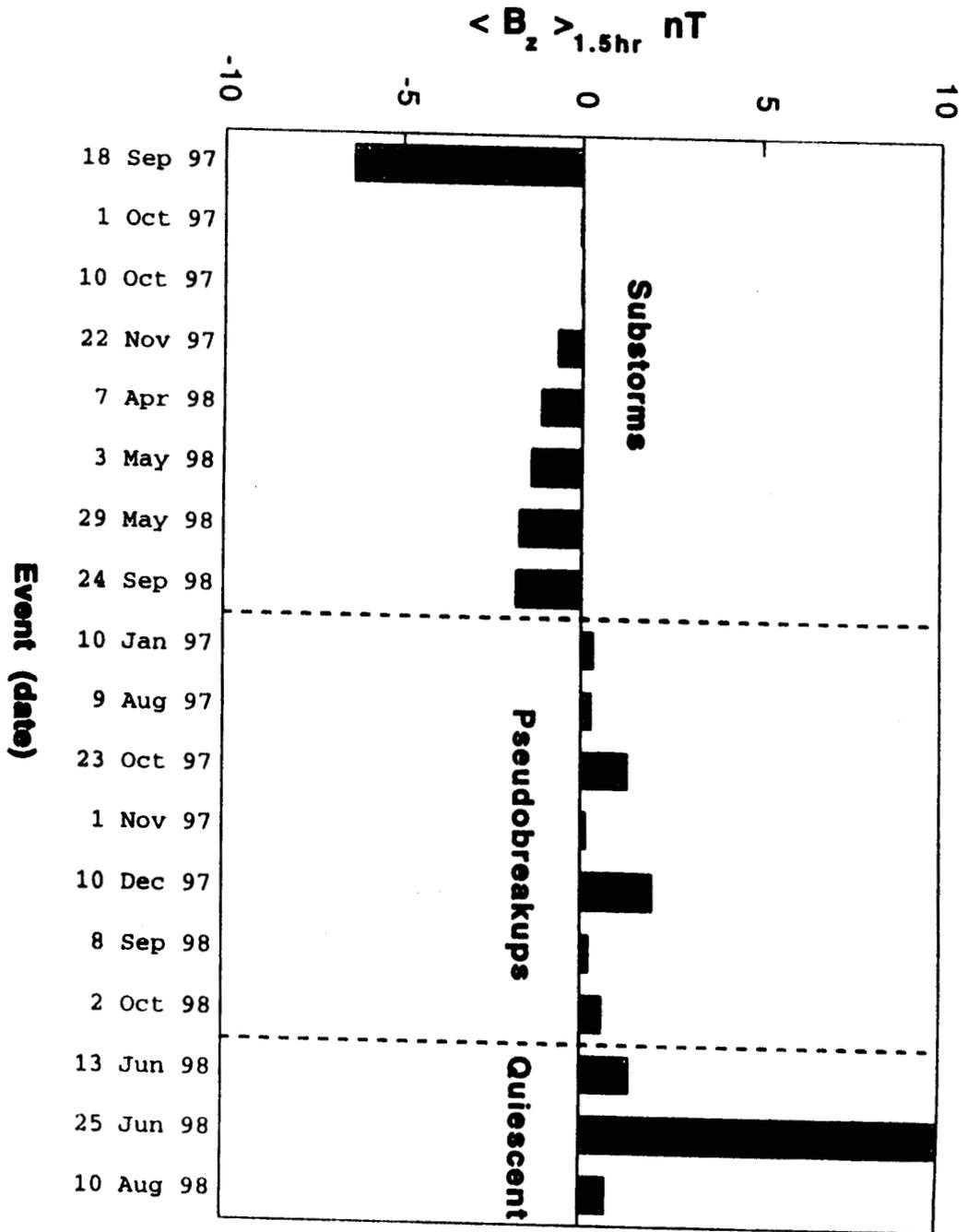
1. Magnetic Reconnection Precursor IMF B_s will lead to near-tail plasma sheet density (Lennartsson and Shelley, 1986) and thermal pressure (Borovsky et al., 1998) enhancements. Tail compression will cause cross-tail current sheet thinning and magnetic reconnection as discussed in Coroniti and Kennel (1972).
2. Current Disruption Decrease in tail diameter and also current sheet compression both lead to cross-tail current density enhancements. Plasma instabilities (Papadopoulos, 1979 and Chang et al., 1990) can lead to current sheet disruption (Lui et al., 1990).

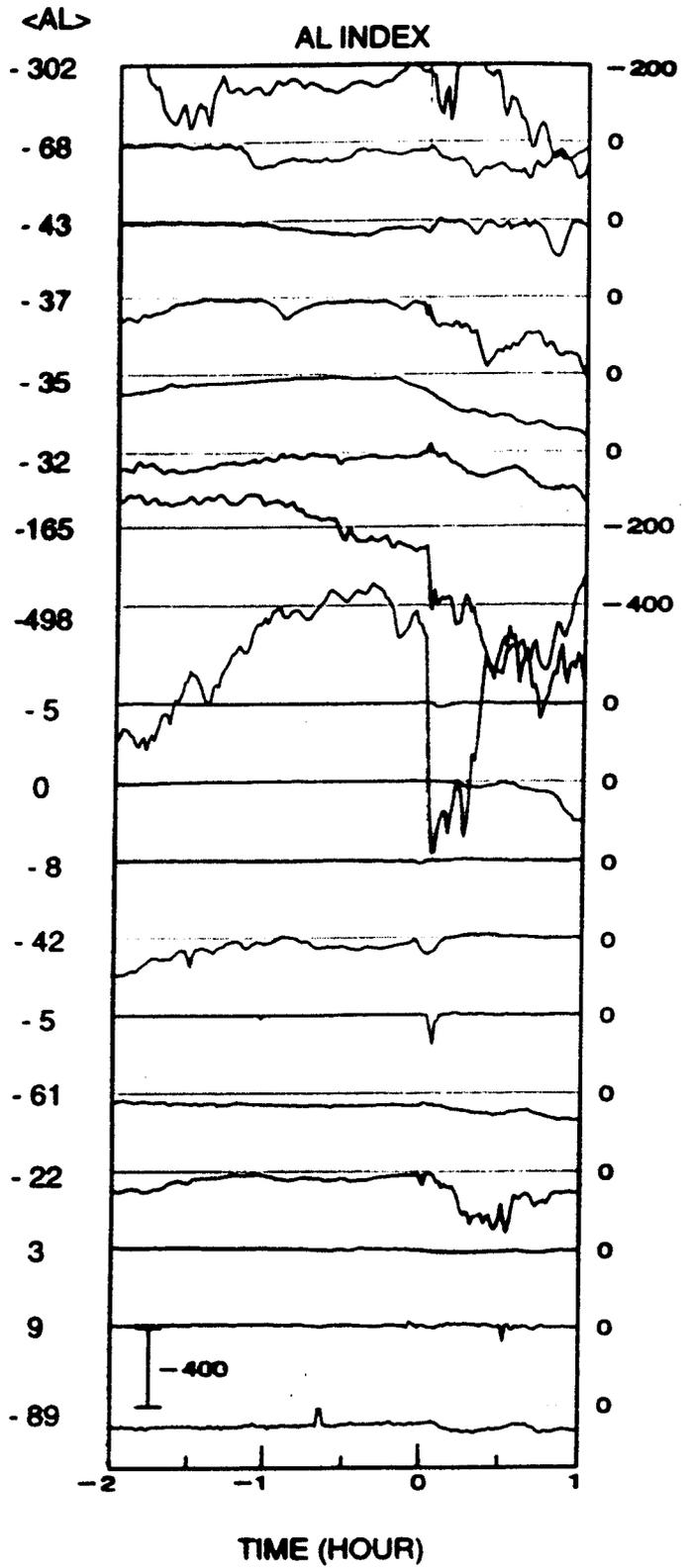
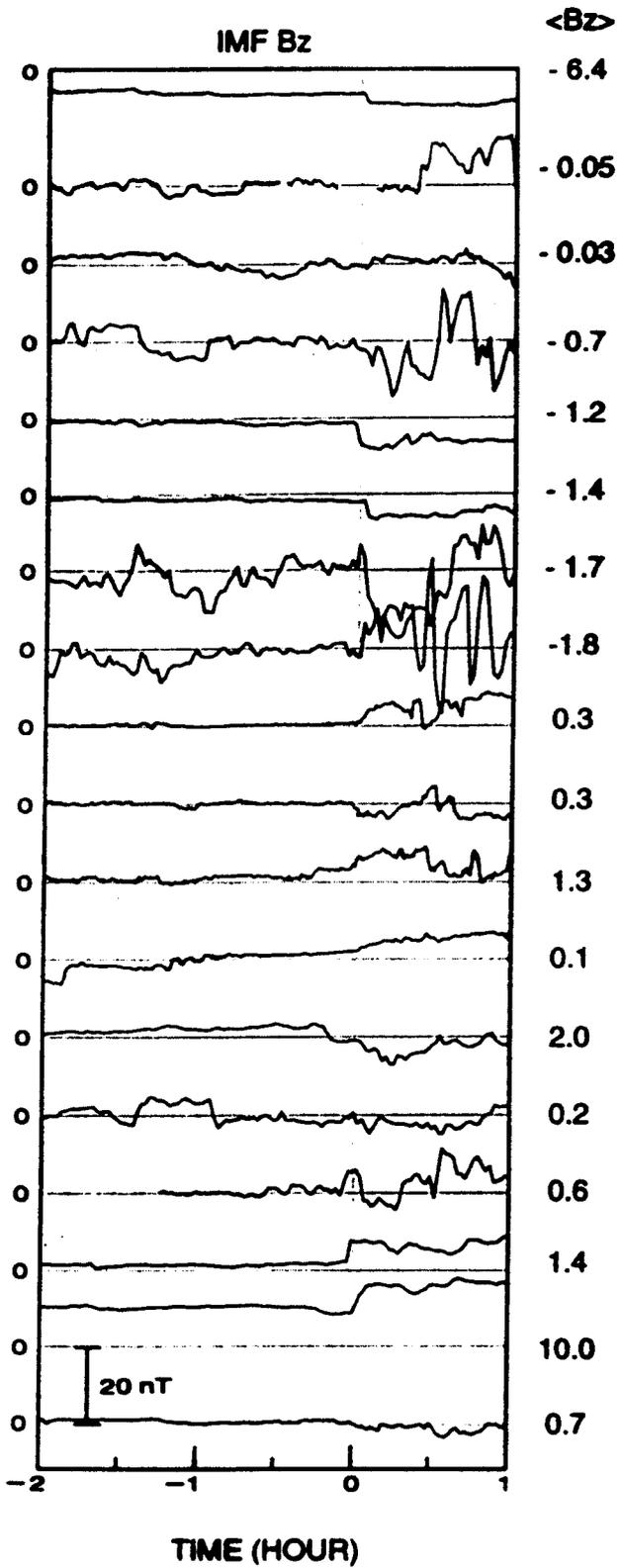
SUMMARY AND CONCLUSIONS

1. Substorm triggering mechanism can be studied using interplanetary shock events. Effects in the magnetotail are large, clear and have small time uncertainties.
2. Interplanetary precursors play a major role in the triggering of substorms, pseudobreakups or nothing (quiescent events). Shock triggering geomagnetic activity can now be predicted?
3. Effects of magnetotail compression are well understood. Specific triggering mechanisms should be tested in this light.

FIG. 13.21. Schematic illustration of the changes in magnetic field and plasma sheet expected in the situation where the reconnection rate on the dayside exceeds that on the nightside. Increased magnetopause flaring, plasma-sheet thinning, and earthward motion of the tail current are the main effects.







An IMF northward turning event is identified by:

- 1) the turning occurred after a period (≥ 30 min) of predominantly negative IMF B_z , at ≤ -2 nT.
- 2) B_z remained elevated for at least 10 min with at least one point at least 2.5 nT higher than at the turning onset.

An IMF southward turning event is identified by:

- 1) The IMF $B_z \geq 2$ nT for more than 5 hr.
- 2) and then, the IMF $B_z \leq -1.5$ nT over next one hour.

The expected time T is:

$$T = T_0 - \tau - T_C$$

where τ is the delay time between magnetopause contacting and the a substorm expansion onset. For Bn event it is ~ 9 min (Lyons et al., JGR, 1997), for Bs event it is ~ 1 hr (Iyemori, JGG, 1980). We examined IMF B_z turning events in a duration of $\Delta T = T \pm 15$ min.

September 24, 1998 event

$R: 19 \Rightarrow 13.3 Re$ (at $X = -15 Re$)

$B_L \Rightarrow 2.1 B_L$ $I \Rightarrow 2.1 I (mA/m)$

$P_L \Rightarrow 4.4 P_L$ $h \Rightarrow h/1.7$ $(PV^\gamma)_{CS} = const.$

$Vy \Rightarrow const.$ $Ey \Rightarrow 1.43 Ey$
